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A TEST OF THE AVERCH AND JOHNSON THEORY
THAT REGULATED FIRMS CROSS-SUBSIDIZE
UNREGULATED COMPETITIVE SERVICES WITH OTHER SERVICES

by



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A THESIS

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The undersigned certify that they have read and recommend to the Faculty of Graduate Studies for acceptance, a thesis entitled "A TEST OF THE AVERCH AND JOHNSON THEORY THAT REGULATED FIRMS CROSS-SUBSIDIZE UNREGULATED COMPETITIVE SERVICES WITH OTHER SERVICES", submitted by J. D. McDonald in partial fulfilment of the requirements for the degree of Master of Business Administration.

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Abstract

A TEST OF THE AVERCH AND JOHNSON
THEORY THAT REGULATED FIRMS CROSS-
SUBSIDIZE UNREGULATED COMPETITIVE
SERVICES WITH OTHER SERVICES

by J. D. McDonald

This study presents the results of a test of the Averch and Johnson theory that a regulated public utility, under certain specified conditions, has an opportunity and an incentive to compete unfairly with its competitors in the supply of unregulated competitive services.

The study investigates the profitability of three services offered by a Canadian telephone company. All three services are unregulated; two are competitive and the other a monopoly. Profitability is measured by the rate-of-return earned by the service and calculated by means of a long-run incremental model. Unfair competition is defined as the earning of a rate-of-return less than the company's overall cost of capital.

The results were not inconsistent with the Averch and Johnson theory. Two services earned a return greater than the cost of capital, and one (unregulated and competitive) generated a substantial loss thereby burdening other services of the company.

Some of the implications of the results to both company management and the responsible regulatory agency are discussed.

TABLE OF CONTENTS

CHAPTER	PAGE
I INTRODUCTION	1
Telephone Industry and Regulation	3
Purpose of the Study	11
Statement of the Research Problem	12
Definition of Terms	12
Hypothesis	16
The Case Study	16
Limitations of the Study	16
Plan of Presentation	17
II THE AVERCH AND JOHNSON ANALYSIS	19
Summary of Analysis	19
Firm's Cost of Capital	27
III PROFITABILITY MODEL	30
Purpose of the Model	30
Long-run Incremental Model	34
Detailed Description of the Model	36
IV RESULTS OF TEST CASES	42
Closed Circuit Television	42
Mobile Telephone Service - Study A	49
Mobile Telephone Service - Study B	68

CHAPTER	PAGE
V SUMMARY AND IMPLICATIONS OF THE RESULT	79
Summary	79
Implications of the Results	80
BIBLIOGRAPHY	82

LIST OF TABLES

TABLE		PAGE
1	Major Telephone Systems in United States	5
2	Major Telephone Systems in Canada	8
3	Gross Investment in CCTV Equipment	45
4	MTS Monthly Flat-Rate Charges	50
5	MTS Message Charges	50
6	MTS Customers by Industry	52
7	MTS Call Routing Patterns	54
8	Direct Revenue from MTS	58
9	MTS Local and Toll Calls	59
10	Original Cost, Depreciation Factor and Maintenance Factor of Equipment Installed Solely for MTS as of December 31, 1968	62
11	Total Company Calls and Total MTS Calls in 1968	63
12	Apportioned Original Cost of Joint Use Equipment as of December 31, 1968	64
13	Direct Costs Generated by MTS in 1968	65
14	Profitability of Company Supplying In-Vehicle Equipment	74
15	Rates for In-Vehicle Equipment	76

LIST OF ILLUSTRATIONS

Figure	Page
1 Optimal Output With Two Input Factors of Labour and Capital	20
2 Firm's Cost-Price Relationship for Maximum Profit	24
3 Conceptual Profitability Model	33
4 Routing of MTS Calls	53
5 The Telephone Network	55

CHAPTER I

INTRODUCTION

The pricing of services offered by a public utility has been a complex and controversial issue involving the public, the company and the industry regulators. In the particular case of telephone (or more recently, telecommunication) utilities, the complexity of the issue has increased as companies, which originally viewed themselves as purely telephone oriented, have broadened their scope to total telecommunications. New service areas include data transmission, cable television, private radio systems and, more recently, computer power and computer application services. Also, new services in existing areas have been introduced such as Wide Area Telephone Service (WATS). A few of these new areas and services are regulated in the same manner as the ordinary telephone service. However, most are unregulated competitive services and this creates an opportunity for a company to subsidize these services by its regulated, monopolistic services.

The telephone industry is monopolistic. This is because the public recognizes the waste of economic resources and inconvenience which would be caused by competition. Thus, telephone utilities are granted geographical monopolies but are also placed under government regulation to protect the public's interest. Regulation of a monopoly serves the same function that competition provides under free enterprise.

Government regulation generally has encompassed four aspects of a company's operations - namely:

- (1) control over the entry of competition
- (2) control over the company's rate structure
- (3) control over the company's profit level, and
- (4) control over the company's quality (grade) of service

This study is concerned with only the first two aspects. The study also approaches these areas from a different point-of-view than normally followed. On the aspect of competition, the usual concern of regulatory bodies centers on preventing duplicate facilities from being constructed to provide identical services. To allow duplication of facilities would not be in the public's interest. On the rate structure aspect, the common concern is over cross-subsidization between regulated and unregulated services. To allow such cross-subsidization could impose an unfair financial burden on customers of the regulated services.

This study investigates the company's rationale in entering new service areas whether such new areas are regulated or not. There are only a very limited number of ways by which a regulated company can improve its financial position in an industry once its rate-of-return reaches the maximum allowable figure. One common method involves expanding the rate base. Since the company earnings are tied to the value of its investments, companies often advocate, particularly during

severe inflationary periods, the substitution of replacement cost valuations for original cost valuations.

However, another not-so-obvious method exists whereby the company is able to offer a new service without concern as to its profitability and be assured of at least the company's allowable rate-of-return. The necessary conditions to make this method advantageous to the company, are that there is no separation of accounts for individual services and that the rate-of-return is applied simply to the total depreciated investment.

Thus, a company may have an incentive to offer a new service without undue concern that the added service will generate the required rate-of-return on investment or even operate at a profit. When this latter situation occurs with a new regulated service, there is cross-subsidization between regulated services - a common and often desirable occurrence. However, when it occurs in the case of an unregulated service, there is the possibility of cross-subsidization between regulated and unregulated services. And with most unregulated services being competitive ones, there exists the added possibility of unfair competition on the part of the public utility.

Telephone Industry and Regulation

Economists Harvey Averch and Leland L. Johnson, in a 1962

study¹ examined in some detail cross-subsidization in the telephone industry in the United States. As an example of a case of cross-subsidization between regulated services and unregulated ones, the "telpak" case involving the American Telephone and Telegraph Company (AT&T) and Western Union (WU) was briefly outlined.

In this section, the characteristics of the telephone industry and its regulation in the United States and Canada are described.

The United States Case

The U.S. telephone industry is dominated by the AT&T Company. The corporate structure of AT&T is comprised of twenty-four operating companies, the Western Electric Company and the Bell Telephone Laboratories. All of these companies are majority-owned by AT&T except for Southern New England Telephone (18%), Cincinnati Bell (27%), and Bell Canada (2%). This complex, known as the Bell System, operated a total of 87 million telephones in the U.S. in 1969. Table 1 shows the major systems operating in the U.S., together with the number of telephones operated.

¹Harvey Averch and Leland L. Johnson, "Behavior of the Firm under Regulatory Constraint", *American Economic Review*, LII (December, 1962), p. 1064.

Table 1
MAJOR TELEPHONE SYSTEMS IN UNITED STATES

Telephone System	Telephones Operated (millions)	Percent of Total
Bell System	87.0	74.6
General Telephone & Electronics	8.7	7.5
United Utilities	1.7	1.5
Continental Telephone	1.0	0.9
Central Telephone & Utilities	0.8	0.7
Independents	17.2	14.8
Total	116.4	100.0

Source: Kurt Borchardt, Structure and Performance of the U.S. Communications Industry, (Boston: Harvard University, 1970), p. 11.

AT&T owns and operates the operating subsidiary of Long Lines which provides the interstate toll telephone communications throughout the U.S. AT&T also furnishes local and intra-state telephone communications via its operating companies. Each of these companies has its own independent organization, property, corporate and capital structure, officials and operating personnel. Each pays a certain percentage of its operating revenue to AT&T for research and development assistance on operating problems.

Regulation of the telephone industry in the U.S. is a joint responsibility of state regulatory boards or commissions and the Federal Communications Commission (FCC). The state authorities regulate all local and intra-state services while the FCC regulates the interstate services. This somewhat artificial division has created a continuing source of conflict between state and federal authorities. The problem behind the conflict is the very nature of the telephone plant. Much of this plant is used for both intra-state and interstate service and an equitable means for apportioning these joint costs is required. Only recently (1970) a joint state-federal board was formed consisting of members of the FCC and the National Association of Regulatory Utility Commissioners (NARUC), to recommend and adopt procedures for joint costs divisions.

The Canadian Case

The telephone industry in Canada has developed along similar lines to those observed in the U.S. Bell Canada occupies much the same role in Canada as AT&T does in the U.S. and controls approximately the same proportion of the nation's telephones. Bell Canada directly owns and has voting control of all major telephone companies east of the Manitoba-Ontario border with the exceptions of Quebec Telephone, and Maritime Telegraph and Telephone. The latter company is directly-owned by Bell Canada but provincial legislation prevents Bell Canada from exercising voting control. The Northern Electric Company is a wholly-

owned manufacturing subsidiary of Bell Canada.

Bell Canada and the British Columbia Telephone Company were formed by a special act of Parliament and as a result are subject to federal regulation. In addition to these two large investor-owned companies there are approximately 2300 small independent telephone companies, three provincially-owned companies and one which is municipally-owned. With the exceptions of the two federally-regulated companies and the one municipally-owned company, all of the above companies are subject to provincial regulation. Canadian National Telecommunications (CNT), a federal crown agency subject to federal regulation, operates the telephone network in the Yukon and, together with Bell Canada, in the Northwest Territories and Newfoundland. Table 2 lists the major telephone systems in Canada and the number of telephones operated.

Table 2
MAJOR TELEPHONE SYSTEMS IN CANADA

Telephone System	Telephones Operated (millions)	Percent of Total
Bell Canada ^b	6.41	69.0
Anglo-Canadian ^a	1.11	11.9
Manitoba Telephone	0.42	4.5
Saskatchewan Telecommunications	0.36	3.9
Alberta Government Telephones	0.47	5.0
Other	0.53	5.7
Total	9.30	100.0

Source: Trans-Canada Telephone System, "Development Planning Results", Montreal, 1970.

a. The Anglo-Canadian figure includes the telephones of British Columbia Telephones, Okanagan Telephones and Quebec Telephones.

b. Included in the Bell Canada figure, are the telephones operated by New Brunswick Telephone, Maritime Telegraph & Telephone, Island Telephone, and Newfoundland Telephone.

Although there is no exact counterpart of the Long Lines organization in Canada, the Trans-Canada Telephone System (TCTS) was formed in 1931 for the similar purpose of developing and maintaining a

coast-to-coast telephone network. The TCTS has eight full-time members and one associate member - the Canadian Overseas Telecommunication Corporation (COTC), a crown corporation responsible for Canada's overseas communications. The full-time members are Bell Canada, British Columbia Telephone, Alberta Government Telephones, Saskatchewan Telecommunications, Manitoba Telephone System, Maritime Telegraph and Telephone, New Brunswick Telephone and Newfoundland Telephone.

Regulation of the Canadian telephone industry is similar to that observed in the United States with one important exception. Whereas the FCC regulates the Long Lines' rates for interstate telephone services, there is no mechanism in Canada to regulate interprovincial telephone services. The federal government regulates all telephone services offered by companies subject to the jurisdiction of Parliament. As provided by the Railway Act, the Canadian Transport Commission (CTC) is the responsible regulatory body. Its jurisdiction extends to the approval of rates and tariffs, operating agreements with other telephone companies, the avoidance of discrimination, and certain interconnection arrangements. The commission does not regulate the quality of service directly, although this factor can be considered in the setting of a "fair" rate-of-return.

Until recently, the emphasis of the CTC was on determining a "fair" return on the company's total operations without regard to the separation of regulated and unregulated services. However, Bill C-111 of Parliament has been enacted which now places all services under the

Commission's scope.

Provincial regulatory boards or commissions which regulate the intra-provincial operations of provincially-chartered companies are still mainly concerned with the determination of a "fair" overall return, with little emphasis on the separation of regulated and unregulated services. The only separation which occurs at present is the issuance of separate financial statements for companies controlled by a parent company but subject to a different regulatory board than that of the parent. For example, Bell Canada directly owns Maritime Telegraph and Telephone which in turn directly owns the Island Telephone Company. The respective regulatory agencies are the Canadian Transport Commission, the Board of Commissioners of Public Utilities for the Province of Nova Scotia and the Public Utilities Commission of the Province of Prince Edward Island.

Another regulatory oddity exists in the Province of Alberta. In this case, the telephone company is owned by the provincial government and operated by a commission, chaired by a provincial cabinet minister. Regulation is the responsibility of the Public Utilities Board, the members of which are appointed by the provincial cabinet. There may be room for argument that the regulatory function of the Board serves no meaningful purpose.

Purpose of the Study

The purpose of this study is to empirically test a hypothesis offered by the research economists Harvey Averch and Leland J. Johnson² regarding the behavior of public utilities under the constraint of government regulation. This hypothesis suggests that utilities operating under regulation have an incentive to expand into other regulated service areas even under conditions of long-term loss in these markets. By so doing, the utility may unduly restrict competition in the marketing of such services by pricing below actual cost.

This study is limited to a case study of the costing and pricing practices employed by a Canadian telephone company. Although the Averch and Johnson statement dealt solely with regulated services, this study studies only unregulated services.

This question of the costing of unregulated services is of current concern to many regulatory bodies. These bodies act to protect the public from unfair pricing of monopolistic services. If regulated utilities are able to cost unregulated services below their long-term incremental costs, then the regulated monopolistic services may be subsidizing the former. Such subsidization, if it occurs, represents a form of "unfair" competition with other firms operating in the same market.

²Ibid.

Statement of the Research Problem

The purpose of this study is satisfied by the determination of the long-run incremental costs and revenues associated with three unregulated services. With such data, it will be apparent whether a particular service is being subsidized by, or is contributing to the company's overall profits.

The determination of the long-run incremental costs is difficult and is subject to judgements whereby future joint costs are apportioned to the appropriate services. Similarly the long-run incremental revenue is dependent on identifying the cross elasticities of demand between competing services. Thus, decisions on the means of apportioning joint costs and determining cross elasticities are essential to the study.

Definition of Terms

The study uses the following concepts in determining the costs and revenues associated with the services:

Incremental costing

This concept refers to the charging of the additional cash outlay plus any enhancements in noncash costs (such as depreciation) attributable directly to an increase in the services offered (rate of output).

Short-run incremental costing

This concept refers to the charging of incremental costs under the assumption that the increased rate of output is temporary and is accomplished solely by an increase in the rate of utilization of the existing plant.

Long-run incremental costing

This concept refers to the charging of incremental costs under the assumption that the increased rate of output is of a long-run nature and is accomplished by an appropriate increase and adaptation of plant capacity

Cost allocation

This concept refers to the assigning of costs, either in part or in full, to one or more services on the basis of the benefit received or by some other logical division.

Fully allocated costing

This concept refers to the apportioning of the total costs involved in providing service to individual services on the basis of the relative incremental costs involved with each service or by some other logical division.

Joint cost

This concept refers to a cost which is common to two or more services and cannot be allocated to these services on purely rational grounds.

Rate base

This concept refers to the total investment on which the company is entitled to a reasonable rate of compensation - commonly valued at original cost less accumulated depreciation and measured in terms of current dollars.

Fair rate of return

This concept refers to the establishment of a rate structure which allows the company to cover its total costs including its costs of capital (both debt and equity capital).

Rate structure

This concept refers to the establishment of prices specific to a type of service and to a type of customer for the various services offered by the company.

Regulated service

This concept refers to a service whose rates although established by the company are subject to approval by a regulatory body.

Unregulated service

This concept refers to a service whose rates are not subject to approval by a regulatory body.

Decreasing cost industry

This concept refers to an industry with a continually decreasing cost per unit value as production increases indefinitely.

Price elasticity

This concept refers to the relative responsiveness of quantity demanded of a service to changes in the price of the service.

Price cross elasticity

This concept refers to the relative responsiveness of quantity demanded of a service to changes in the price of another service.

Hypothesis

The study tests the following hypothesis:

Rates established for unregulated services are not adequate to cover the long-term incremental costs plus the allowed rate-of-return, thereby permitting the possibility of cross-subsidization between unregulated and regulated services.

The Case Study

The case study was conducted in a telephone utility operating in Canada.

The company operates toll and local exchange networks and offers a wide variety of other-than-telephone communication offerings such as video pick-ups, broadcast transmission facilities and paging services. A government appointed board regulates the company's rate structure, profit levels and grade of service.

Limitations of the Study

The study is limited to three unregulated services offered by one regulated telephone company. The conclusions would have been strengthened if the study had included several additional unregulated services and also had investigated other telephone companies.

There is no lack of services to study. Unregulated services

include TWX (Teletype Exchange) service, PBX (Private Branch Exchange) service, data services, WATS (Wide Area Telephone Service), WADS (Wide Area Data Service), network television service, private mobile telephone systems, paging systems, telephone extensions and inter-provincial toll service.

Although there is no lack of services to study, there is a very definite lack of adequate and relevant data. Additional information is required to permit the drawing of definitive conclusions in such problem areas as the apportioning of joint costs to the various services, the determination of price cross elasticities between competing services (for example, between WATS and toll message charges), and the specification of a long-run cost function for the industry (the telephone industry is often characterized as a decreasing-cost industry but no substantive evidence exists to support the claim).

Plan of Presentation

Chapter II presents in summary form the Averch and Johnson analysis of a public utility expanding under the constraint of government regulation. Chapter III outlines the profitability model employed by the study to identify the incremental revenue and cost generated by each of the test services. Chapter IV presents the detailed profit analysis of the three test cases. Chapter V consists of the summary and conclusions of the study and a discussion of the implications of

the conclusions for the company's management and the regulatory agency.

CHAPTER II

THE AVERCH AND JOHNSON ANALYSIS

Summary of Analysis

Harvey Averch and Leland Johnson, in their paper³, "Behavior of the Firm Under Regulatory Constraint", developed a theory designed to explain the behavior of a monopoly operating under the constraint of public regulation. The authors considered two cases: one in which the firm operated in a single market subject to regulation, and a second, in which the firm operated in several markets subject to public regulation on its overall operations.

The Single-Market Case

In this case, Averch and Johnson demonstrated that a firm producing a single product with two factor inputs, labour and capital, has an incentive, subject to one necessary condition, to substitute capital for labour at the expense of a "socially" optimal ratio of these two factors. The necessary condition being that the rate of return allowed by the regulatory agency is greater than the firm's cost of capital but less than that of an identical but unregulated firm.

Figure 1 demonstrates this case graphically. The factor

³Ibid.

input of labour is plotted on the vertical axis and capital on the horizontal axis. Isocost curve A represents the combinations of input factors giving a constant cost. The isoquant curve P_1 shows all possible combinations of the input factors leading to a given level of production. The point of tangency of isocost curve A to isoquant curve P_1 , denotes the optimal combination of capital and labour to produce a given output.

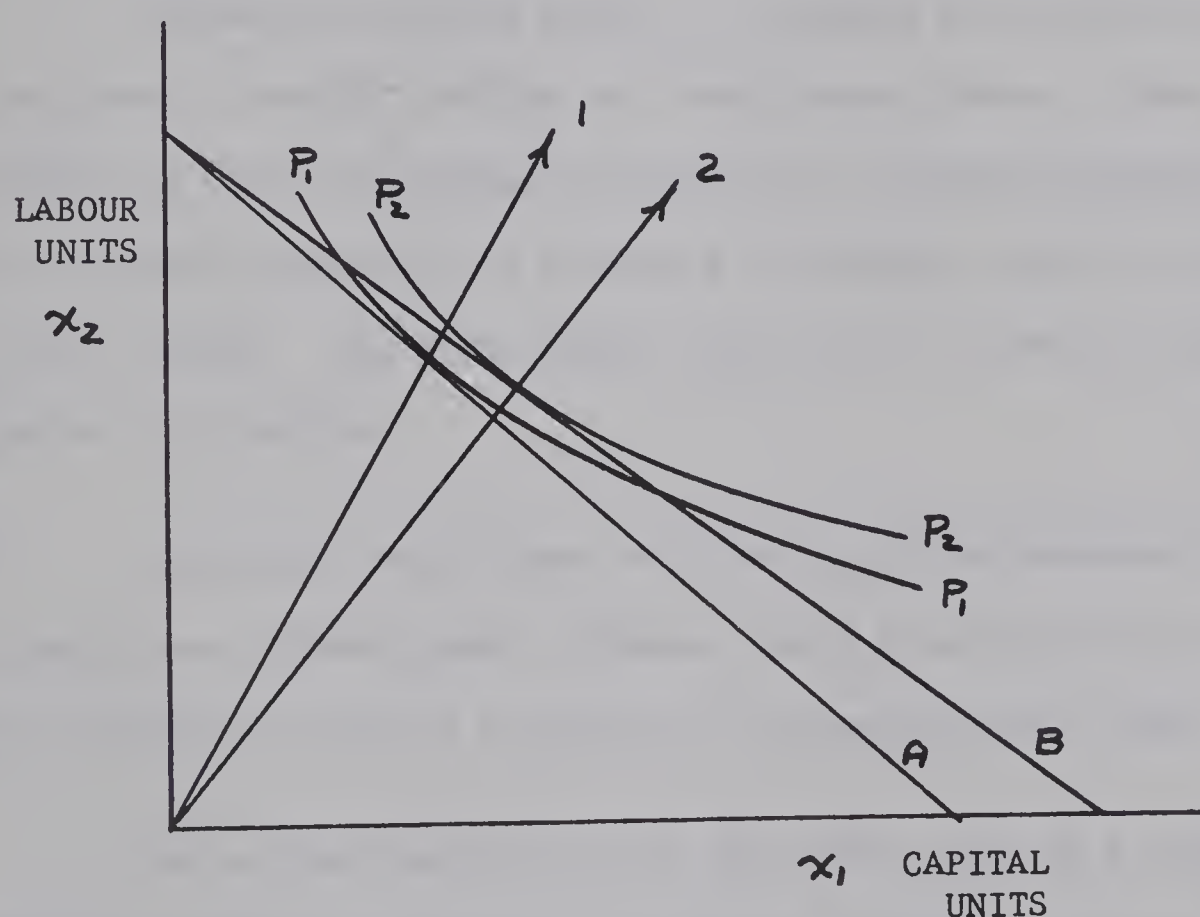


Figure 1 --- Optimal output with two input factors of labour and capital

The unregulated firm would expand production along expansion path 1, always minimizing the total factor cost for any given production level.

However, for the firm operating under the constraint of regulation, the cost of capital is lower than the market place cost of capital. This situation arises as a result of the firm being allowed to earn a rate of return greater than its cost of capital. For example, if during a period when the market cost of money is 5%, the regulatory agency allows a rate of return of 6%, then the effective cost of capital to the regulated firm is 4%⁴.

Regulation has the effect of changing the relative cost of factor inputs, thereby leading to a new isocost curve. Curve B is now relevant and the firm expands production by following expansion path 2. This expansion path does not produce a "socially" optimal utilization of factor inputs. The firm simply finds path 2 as the one which maximizes its profits.

The single-market case was developed also mathematically in the Averch and Johnson paper. However, only a portion of the development is presented here as a lead-in to the multi-market case.

The production function of the firm producing a single homogeneous product by means of two factor inputs is defined as

$$Z = \text{function } (x_1, x_2) = Z(x_1, x_2)$$

⁴To be correct in the practical application of the theory, the market cost of capital is the average embedded cost of capital to the firm.

where x_1 (the capital input) ≥ 0

x_2 (the labour input) ≥ 0

(1) and $z(0, x_2) = z(x_1, 0) = 0$ That is, both factor inputs are non-negative and production requires both inputs.

Also, the marginal product of each factor is positive, i.e.,

$$\frac{\partial z}{\partial x_1} > 0 \quad \frac{\partial z}{\partial x_2} > 0$$

The demand function is defined as

$$(2) \quad p = \text{function}(z) = p(z)$$

By employing the following definitions, the firm's profit and the regulatory constraint can be expressed in equation form.

π = firm's total profit in dollars

p = selling price of the firm's product in dollars

z = firm's total production in units of product

x_1 = firm's total usage of capital in dollars

x_2 = firm's total usage of labour in man-hours

r_1 = firm's cost of capital, i.e., the cost of holding capital in the form of plant, expressed as a percentage of total plant

r_2 = firm's average hourly labour rate in dollars

c_1 = firm's acquisition cost of plant expressed as a percentage of total plant⁵

u_1 = depreciation expense charged against revenues of the period under study, expressed in dollars

U_1 = the total accumulated depreciation expressed in dollars

a_1 = the rate of return allowed by the regulatory agency, expressed as a percentage of total net plant (i.e., total plant less accumulated depreciation).

It is assumed that the input factor costs are linear with production. Operating profit is then determined as total revenues less total expenses or

$$(3) \quad \pi = p_3 - r_1 x_1 - r_2 x_2$$

The regulatory constraint is defined by limiting the ratio of net operating profit (total revenues less total non-interest expense) to net plant (total acquired plant less accumulated depreciation) to less than or equal to the allowed rate of return or

$$(4) \quad \frac{p_3 - r_2 x_2 - u_1}{c_1 x_1 - U_1} \leq a_1$$

For simplicity, c_1 is assumed equal to 1 and u_1 and U_1 are both assumed to be zero.

⁵The acquisition cost of plant, might in practice, differ from unity due to factors such as goodwill, revaluation and donations.

The regulatory constraint is then reduced to

$$\frac{p_2 - r_2 x_2}{x_1} \leq r_1 \quad \text{or}$$

$$(5) \quad p_2 - r_2 x_2 - r_1 x_1 \leq 0$$

The Multi-Market Case

In the multi-market case, it is assumed that the firm is allowed to enter new regulated markets. It is further assumed that the regulatory agency determines the firm's rate-of-return on a collective basis rather than on an individual service basis.

Consider the extreme case where by operating in a second market, the firm is able to operate as an unconstrained monopoly in the first market. Under this condition, the firm would operate at output OA in figure 2, thereby maximizing its profits in market 1.

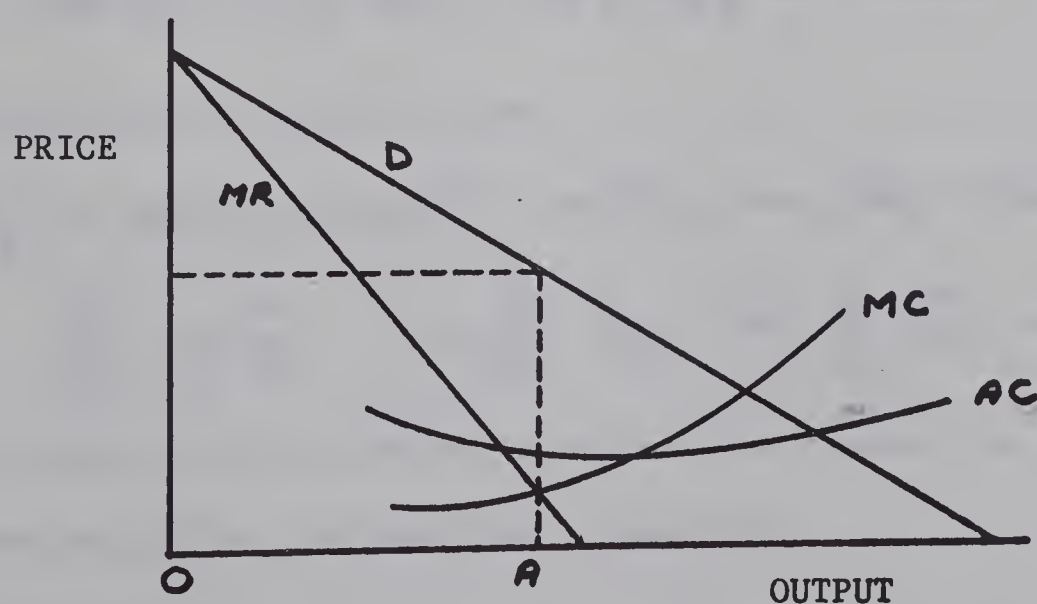


Figure 2 --- Firm's cost-price relationship for maximum profit

Also, assume that the firm is just able to break even in the second market by expanding along the socially optimal path 1. That is, for any combination of input factors into the second market, x_{12}, x_{22}

$$(6) \quad p_2 \bar{z}_2 - r_1 \bar{x}_{12} - r_2 \bar{x}_{22} = 0$$

Expanding (5) for the multi-market case gives

$$(7) \quad \sum_{i=1}^n p_i \bar{z}_i - r_1 \sum_{i=1}^n \bar{x}_{1i} - r_2 \sum_{i=1}^n \bar{x}_{2i} \leq 0$$

By denoting the output and input factors of market 1 as $\bar{z}_1$ and $\bar{x}_{11}, \bar{x}_{21}$ at which the unconstrained profit is maximized, the excess profit earned above that which would be allowed under regulation is given by,

$$(8) \quad p_1 \bar{z}_1 - r_1 \bar{x}_{11} - r_2 \bar{x}_{21} = m, \quad m > 0$$

Now, however, the firm can choose a level of capital input into market 2 such that

$$(9) \quad p_2 \bar{z}_2 - r_1 \bar{x}_{12} - r_2 \bar{x}_{22} = -m$$

Adding equations (8) and (9) gives

$$(10) \quad p_1 \bar{z}_1 + p_2 \bar{z}_2 - r_1 \bar{x}_{11} - r_1 \bar{x}_{12} - r_2 \bar{x}_{21} - r_2 \bar{x}_{22} = 0$$

$$\sum_{i=1}^2 p_i \bar{z}_i - r_1 \sum_{i=1}^2 \bar{x}_{1i} - r_2 \sum_{i=1}^2 \bar{x}_{2i} = 0$$

which is equation (7) with $n=2$, and thus the company on its overall operations satisfies the regulatory constraint.

The key observation to be made is that an unregulated firm

would not have an incentive to operate in market 2, since the additional revenues would only cover the additional expenses, i.e., there would be no gain in profit level.

A regulated firm would find market 2 attractive because it can increase the rate base at "no loss"; i.e., for any capital input in market 2 the output generates revenues just equal to the input factor cost.

Equation (10) can be rewritten as

$$\sum_{i=1}^2 p_i \bar{x}_i - (r_1 + a) \sum_{i=1}^2 \bar{x}_{1i} - r_2 \sum_{i=1}^2 \bar{x}_{2i} = 0$$

where "a" represents the amount by which the allowed rate of return exceeds the cost of capital to the firm. Thus, the regulated firm is able to increase its profit by $a \bar{x}_{12}$. In fact, the firm has an incentive to operate even at a loss in market 2, provided that the loss does not exceed $a \bar{x}_{12}$.

Furthermore, if market 1 is an inelastic monopolistic service such as basic exchange telephone service, the regulated firm may enter market 2 without undue concern as to its profitability. Equation (10), the regulatory constraint equation, can always be satisfied by simply adjusting the magnitude of m to equal the loss incurred in market 2. Thus the regulated firm has an incentive to operate in market 2 provided the firm's cost of capital is less than the allowed rate-of-return.

Averch and Johnson concluded, "In the literature on public utility economics, concern is frequently expressed that the firm will attempt to inflate its rate base to increase its profit. However, the problem is generally viewed as one of proper valuation of rate base, i.e., the firm would always have an incentive to have its property stated at a value higher than its cost. The problem has given rise to a great deal of controversy about proper valuation, especially concerning original versus reproduction cost, and depreciation policy. In the present study, the problem of rate-base inflation is not viewed as one of valuation but rather as one of acquisition - quite apart from the problem of placing a valuation upon the rate base, the firm has an incentive to acquire additional capital if the allowable rate of return exceeds the cost of capital".

Firm's Cost of Capital

The Averch and Johnson analysis rests on the necessary condition that the rate of return allowed by the regulatory agency is

- (a) greater than the firm's cost of capital, and
- (b) less than that of an identical but unregulated firm.

The firm under study has no equity capital except that which is generated internally and retained by the firm for future expansion of plant and facilities. Retained earnings represent approximately 11% of total capital. The responsible regulatory agency recognizing a

heavy emphasis on debt financing set the firm's rate of return at 5.2% on debt capital and 9.0% on equity capital. Combining these two in direct proportion to their relative percentages of total capital, resulted in an overall rate of return of 5.9% on the allowable rate base.

The agency admitted that the 9% rate of return established for equity capital was an arbitrary figure but considered it reasonable.

In establishing the 5.2% return on debt capital, the agency employed both the then current embedded cost of capital, calculated to be 5.06%, and the estimated cost of debt capital in the immediate future. The latter was estimated at 5.5%.

It can be concluded that the first part of the necessary condition for the Averch and Johnson analysis does exist in that the firm is allowed to earn a return of 5.9% on any new capital (including debt capital) whereas the estimated actual cost of such capital is 5.5%.

The second part of the necessary condition, that of the allowable rate of return being less than that of an identical but unregulated company could be accepted on the basis that 5.9% is well below what unregulated firms would accept as being reasonable. However, there is in Canada, a specific example - namely, that of Edmonton Telephones. This company is a municipally-owned telephone

utility, operating without any form of regulation. The City of Edmonton's annual report for the year 1969, indicates that Edmonton Telephones had a rate of return (before debt charges) of approximately 13% or slightly more than double the return allowed by regulatory agency of this case study.

Therefore, the second part of the necessary condition has been demonstrated to exist for this test study.

CHAPTER III

PROFITABILITY MODEL

Purpose of the Model

The Averch and Johnson hypothesis maintains that a publicly regulated firm has an incentive to enter new business areas and, under certain regulatory conditions, can do so without undue concern as to the profitability of the ventures. One of the necessary regulatory conditions is that the allowable rate of return established for the firm be tested by comparing the total net income of the firm to its total assets rather than calculating an individual rate of return for each major service area. By following this practice of calculating only a single rate of return for the firm as a whole, the firm has the opportunity to shift revenues and/or expenses from one service to another without affecting its income position.

The methods available to the firm for accomplishing this cross-subsidization are varied. On the revenue side, the firm could exploit the cross elasticity between two services by increasing the rate structure of one to shift demand to the other. This would be particularly appealing to the firm if the demand for the service in question possessed a high price elasticity while that of the competing service, a low price elasticity. Another revenue ploy involves the crediting of revenues to a service which are not totally and clearly created by that service. On the costs side, the firm can lower the

costs actually charged to the service by providing certain support functions at no cost or below the service's fair share of such costs and also by allocating joint costs by some criterion which favours the service.

In view of the possibility of cross-subsidization among services and, in particular, between regulated and unregulated services, regulatory agencies are faced with a major information problem. The Common Carrier Bureau of the F.C.C. has stated its position in this regard as follows⁶: "We are seeking ratemaking principles which, when applied to the Bell System's interstate services, will enable the Commission to evaluate the rate level relationships among the services. Of specific concern is the possibility of undue discrimination, which we define in the economic sense as the establishment of a rate level for a relatively competitive service below that level which would minimize the rates for the monopoly services. The search is for guidelines by which the Commission can determine whether or not the monopoly services are subsidizing the competitive services, and if so, how the rate levels should be changed."

The concern for providing adequate information to the

⁶Economic Studies Division, Common Carrier Bureau, F.C.C., "Comments on Bell System Statement of Ratemaking Principles and Factors Relating to the Determination of Proper Rate Levels for the Principal Categories of Interstate Services", Testimony under Docket 16258 and 15011, F.C.C., Washington, 1968.

appropriate regulatory agency has been evident in Canada also. For example, the Canadian Transport Commission (CTC) which regulates Bell Canada and other federally chartered telecommunication companies, recently had its jurisdiction expanded by Parliament to include the private line services of these companies. For the next rate hearing of Bell Canada, the CTC instructed the company to prepare separate revenue, costs and rate-of-return statements for its private line services. More recently, in September of 1969, the Department of Communications established the so-called Telecommission - the preparation of a group of studies on the Canadian telecommunications industry. As one writer put it, "The department's efforts are aimed at one basic goal: finding more effective means of regulating the industry".

The model employed by this study has essentially one purpose - to identify the actual long-run incremental revenues generated by a service, both direct and indirect, and the actual long-run incremental costs incurred by the company in generating this revenue. A simplified conceptual diagram of the model is shown as figure 3.

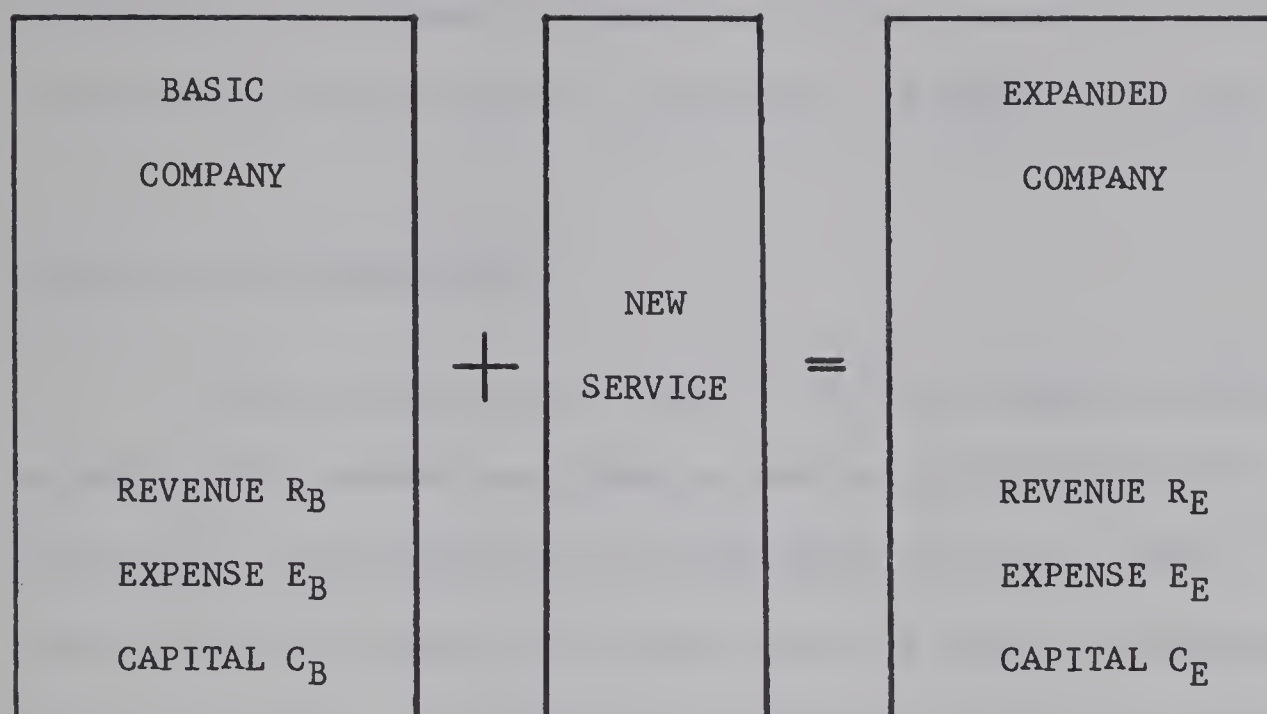


Figure 3 --- Conceptual profitability model

This model is designed to identify the incremental effect created by the addition of a new service. The basic company is considered to be composed of only monopoly-type services, that is, services which are available only through this company. The new service is considered to be competitive, that is, the prospective customer has more than one source of supply. Under this model, the rate-of-return provided by the additional service may be expressed algebraically as:

$$\text{Rate-of-Return (percent)} = \frac{(R_E - R_B) - (E_E - E_B)}{C_E - C_B} \times 100$$

Although this study uses the concept of the model per figure 3, the effect of the additional service is more easily found by

identifying the revenue, expense and capital associated directly with the services rather than by a comparison of before and after values.

Long-run Incremental Model

There are two basic models used by telephone companies to establish the revenue requirements and the profitability of a service. Both models are restricted to an analysis of costs. These are the fully allocated costing (FAC) model and the long-run incremental costing (LRIC) model. The essential difference between the two models involves the treatment of so-called sunk costs⁷. The FAC model allocates a portion of the company's sunk costs to a new service whereas the LRIC model treats such sunk costs as irrelevant.

The Averch and Johnson analysis assumes the use of a LRIC model⁸. In their article, the authors criticize an FCC study for using costs developed via an FAC model as follows: "Second, the rates of return quoted above are based on 'fully allocated costs' as opposed to marginal cost. In our model, the firm operates at a loss in a market only if the additional revenues it receives by operating in that market

⁷Also referred to as historical costs - costs which have been incurred in the past and thus irrelevant to present decision-making.

⁸Harvey Averch and Leland L. Johnson, "Behavior of the Firm under Regulatory Constraint", American Economic Review, LII (December, 1962), p. 1064.

are below the additional costs."

The LRIC model, although long advocated by academic economists, has only partially been accepted by regulatory agencies. For example, in 1968 the Economic Studies Division of the F.C.C. stated⁹, "We emphasize, however, our belief that measurements of LRMC (LRIC) and other cost functions, demand elasticities and cross elasticities are vitally important to the establishment of an efficient set of rate levels and rate structures". This represents the opinion of professional economists employed by the F.C.C. Yet in 1970, an F.C.C. ruling was based on an FAC model and was criticized by the Air Transport Association as such¹⁰, "to be an improper prejudgement of the weight or emphasis to be given 'historical costs', and thus to fully distributed costing, in the ultimate 'determination' of the 'appropriate rate level for each of Bell's major categories of service', and should therefore, in all fairness, be promptly recinded". The telephone industry, on the other hand, fully accepts the LRIC model as correct and appropriate.

⁹Economic Studies Division, Common Carrier Bureau, F.C.C., "Comments on Bell System Statement of Ratemaking Principles and Factors Relating to the Determination of Proper Rate Levels for the Principal Categories of Interstate Services", Testimony under Docket 16258 and 15011, F.C.C., Washington, 1968.

¹⁰Telecommunication News, Washington, D.C., Volume 36, No. 11, March 16/70, p. 11.

The FAC model gained much of its acceptance from the view that the telephone industry was a decreasing-cost industry and use of marginal costing would lead to total costs exceeding total revenues. However, the establishment of a rate structure based on an LRIC model sets only the lower floor for rates; that structure which guarantees that a service will not be a burden on other services. In practice, rates would be set above this floor in relation to the price elasticity of the service.

Detailed Description of the Model

As outlined at the beginning of this chapter, the purpose of the model is to identify the profitability of a service. To do this, the model must identify the long-run incremental revenues and costs generated by the service. Figure 4 is a detailed representation of the LRIC model. In order to explain the components of the model, the service of Wide Area Telephone Service (WATS) is discussed. WATS provides flat-rate long-distance calling within a specified geographical area in a manner analogous to the common flat-rate exchange calling prevalent throughout North America. It particularly appeals to businesses which demand person-to-person communication such as brokerage firms and the sales departments of many firms.

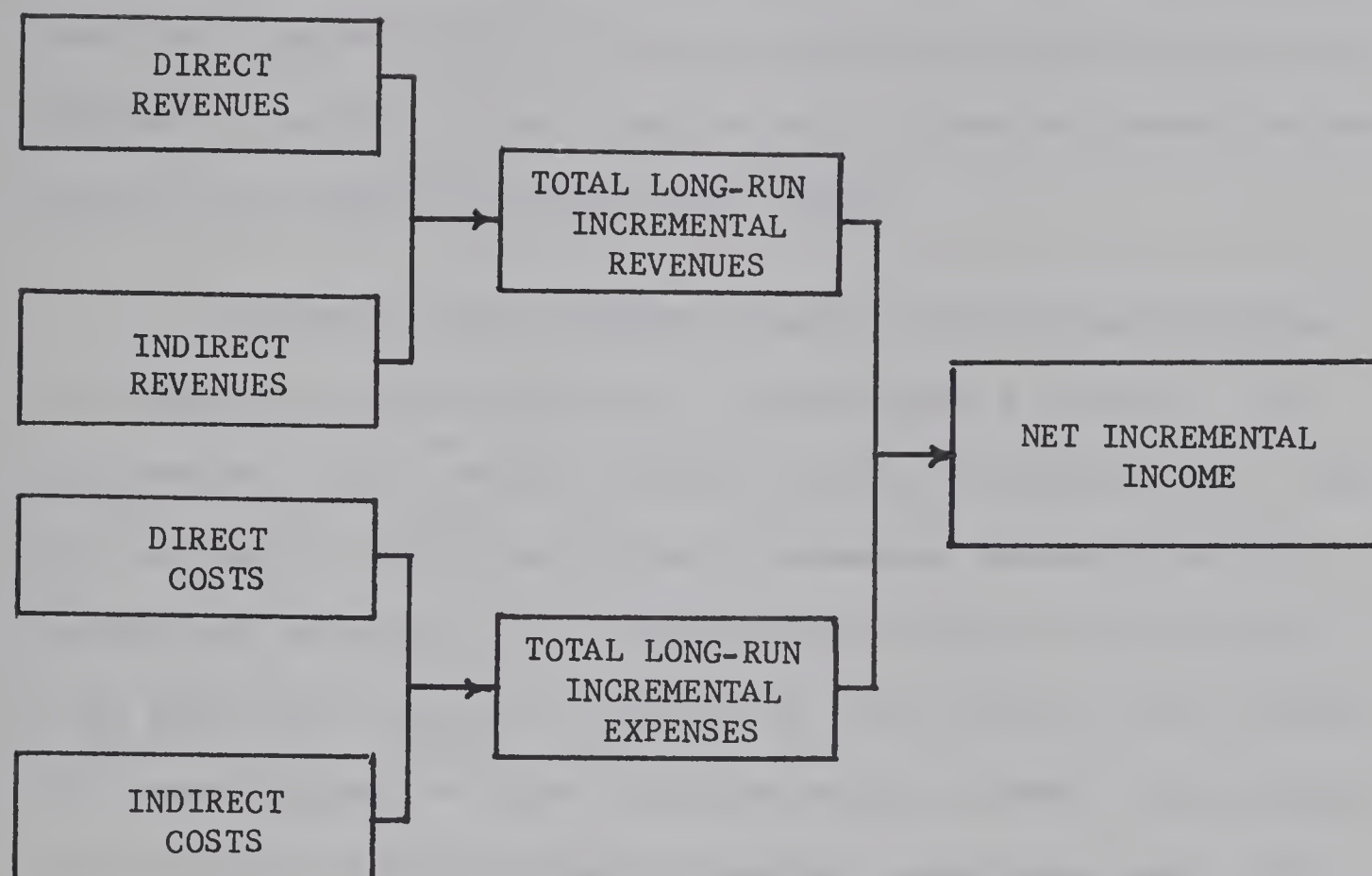


Figure 4 --- Detailed Profitability Model

Revenues

The model calls for the long-run incremental revenues generated by the service. This includes direct revenues such as the monthly flat-rate charges for the WATS plus the net total of indirect revenues generated by the service. This net total could be negative or positive. For example, when a firm contracts for WATS, the personal long-distance calling habits of the firm's employees could be affected in at least

two ways. On one hand, the employees might utilize the WATS for personal calls and thereby reduce the revenue normally expected from residential long-distance usage. On the other hand, having unlimited "free" long-distance calling during business hours might increase the employees' propensity to use long-distance at home and thereby increase revenue from residential long-distance usage.

In general, the telephone company's accounting procedures are adequate to identify the direct revenues from a service. The determination of net indirect revenue is not so straightforward. However, the factors affecting indirect incremental revenue should be itemized and, at worst, crude estimates made of their contribution. In the WATS case, without the benefit of factual data on the residential revenue before and after the introduction of WATS, the assumption could be made that the two factors exactly counter each other. But this one-for-one correspondence may not continue. By itemizing the factors, changes become more apparent and are not overlooked in future analyses.

Although the price elasticity of the service and the price cross elasticities between the service and other services are germane to the question of the maximization of total company revenue, they are not relevant to this model or study. The sole purpose of the revenue portion of the model is to identify what the incremental revenue is - not to identify what it might be under optimization.

Costs

A major requirement of the model is to identify the costs created by the service using an LRIC model. No exact definition of long-run is given, although the normal time period will be three to five years. The crucial point is to include all significant costs incurred in the present and future as a result of providing the service. As under revenue, costs are segregated into direct and indirect costs.

Direct costs are directly attributable to the service and includes equipment purchased specifically for the service, and the labour required to introduce the service. For WATS, direct costs are the necessary modifications to the customer's circuit, the development of rate structures, and the direct administration of the service.

Indirect costs are not readily identified with the service but are incurred only if the service is provided. The primary item in this cost category is the cost involved in the advancement of relief projects undertaken to increase the capacity of individual facilities or the telephone system as a whole. Again referring to the WATS example, the major indirect cost might be the advancement of relief projects to handle a large increase in toll traffic motivated by the removal of message rate charges.

Certain of both the direct and indirect costs may be identified as joint costs between the service under study and other services.

Such costs must be apportioned to the relevant services in an equitable manner. The accepted criterion for this apportioning is usage. That is, if service A uses a particular facility 8% of the available time and service B uses it 4%, then the cost of the facility is apportioned 2/3 to service A and 1/3 to service B. However, the appropriateness of this method of apportioning joint costs has been under question for some time.

In an article published in 1963, Curtis M. Bushnell¹¹ reviewed the existing allocation procedure for toll and local service and concluded that the existing cost division favoured toll service. Allocation procedures have also been the subject of recent discussions between the F.C.C. and the National Association of Regulatory Utility Commissioners (NARUC). A. Smith¹², Chairman of the NARUC, has commented, "obviously the paramount criterion employed in the separation of all telephone plant has been far too heavily based on actual time in use, with far too little consideration being given to idle time which someone must pay for. Accordingly, the primary criterion for the separation of telephone plant is consistent with the character of the toll business but inconsistent with the character of exchange business".

¹¹Curtis M. Bushnell, "Regulatory Responsibilities in Telephone Cost Allocations", Public Utilities Fortnightly, Part 1: 72 (November 7, 1963), 52 - 65, Part II: 72 (November 21, 1963), 32 - 45.

¹²Telecommunication News, Washington, D.C., Volume 36, No. 9, March 2, 1970, p. 6.

If idle time had been charged equally in the example involving services A and B mentioned above, the cost of the facility would have been apportioned¹³ 52% to service A and 48% to service B (compared to 67% and 33% under the present usage method).

¹³Apportioning the 88% idle time equally the services and adding service usage gives 44% + 8% for service A and 44% + 4% for service B.

CHAPTER IV

RESULTS OF TEST CASES

Chapter IV presents the results of three studies of selected competitive services offered by the firm. Each study employs the profitability model outlined in Chapter III. In certain studies, the characteristics of the services and of its administration enables certain simplifications to be made to the model. In each study, the foremost objective was to determine the profitability of the service.

Closed Circuit Television

Service Description

Closed circuit television (CCTV) is a term used to describe any dedicated television transmitting - receiving system. Functionally, a CCTV system is identical to a public television system except for the single aspect of a CCTV having a numbered and controlled audience. The audience of a public system is limited only by the technical capabilities of the television transmitter and by the geographical location of the receiver and its technical capabilities. Under normal conditions, any receiver within a 20-50 mile radius of a public television station's transmitter is capable of receiving the broadcast signal. Under a CCTV system only receivers specifically connected to the system are able to receive the transmitted signal. The connection is not limited to a

physical hookup of transmitter and receiver although this is the normal occurrence; connection can also be achieved via radio transmission.

Television systems such as cable television, educational television and pay television are not included under CCTV systems because although their audiences are controlled, or can be controlled, they are not limited in number. Typical CCTV applications are the surveillance of people (customers, employees, prisoners) and property (libraries, schools, fenced storage areas), the training of people (drama workshops, athletic training programs, surgical techniques), the monitoring of dangerous processes (nuclear testing, planetary exploration, underwater inspections).

The equipment required for the basic CCTV installations is readily available from a variety of manufacturers and includes television cameras, television receivers and video recorders. More complex installations include channel switchers, line amplifiers and interconnecting radio systems.

CCTV systems are highly competitive. In the province in which the study was conducted, there are over ten private firms, in addition to the telephone company, providing this service. Some of this competition involves major firms such as Ampex of Canada, Automatic Electric CCTV Systems and RCA.

Service Revenue

The revenue generated for the company by CCTV service in 1969 was \$103,500¹⁴. This figure represents the total monthly charges billed to customers of CCTV service during 1969. No indirect revenue has been credited to or against the service. First because of the lack of a substitute service offered by the company and second as there is no evidence of an enhancement of other company revenues by CCTV service.

Normally a small correction factor would be applied to the \$103,500 to allow for uncollectable revenue. However, in this instance, no correction factor was applied for two reasons. One, the company could not provide a reliable estimate of the factor, and second, most customers of CCTV service are on-going businesses and the chance of a defaulted payment is minimal. Thus, \$103,500 is the total incremental revenue generated by CCTV service in 1969.

Service Costs

The main direct cost involved in providing CCTV service is the depreciation expense associated with capital investment in CCTV

¹⁴As compiled from the company's monthly market analysis reports. The company has a revenue account entitled, television, but this account contains television revenue other than CCTV revenues (e.g., network television revenues).

plant and equipment. Table 3 gives the gross investment in CCTV plant and equipment over the past three years.

<u>December 31</u>	<u>Gross Investment</u>	<u>Incremental Investment</u>
1967	28,700	-
1968	807,500	778,800
1969	1,213,800	406,300

Table 3 --- Gross Investment in CCTV Equipment

Reference to table 3 shows that investment totalling \$778,800 was made in 1968 and an additional investment of \$406,300 in 1969. The company does not maintain separate accumulated depreciation accounts for each asset account, so an estimate of depreciation expense must be made. The life of CCTV equipment is estimated at seven years, giving a depreciation expense of 14.3% annually based on straight-line depreciation¹⁵. Ignoring the beginning investment of \$28,700, the

¹⁵The company uses the equal-life group depreciation method which is based on mortality experience with the equipment. Consider the simple example of purchasing ten identical units at \$100 each. Life studies on similar units indicate that three units will fail after one year, four after two years and three after three years. The average useful life is $\frac{3(1) + 4(2) + 3(3)}{10}$ or two years. By ordinary

straight-line depreciation, \$500 depreciation expense would be charged for each of the first two years. Under the company's modified method, depreciation for each year reflects the actual consumption of the units. Thus depreciation for the first year is $3(100) + 1/2(4)(100) + 1/3(3)(100) = \600 . Depreciation in the second and third years is \$300 and \$100 respectively.

depreciation for 1969 was calculated by charging a full-years expense against the \$778,800 investment added in 1968 and a half-years expense for the \$406,300 added in 1969.

Property taxes are another direct although small cost. The cost for 1969 was estimated in a similar manner to depreciation. A full 0.6% was applied to the \$778,800 and a half, or 0.3%, to the \$406,300. Total direct cost, then, was \$146,000; \$140,200 for depreciation and \$5,800 for property taxes.

The primary indirect costs are those of maintenance and administration. Since the study is concerned only with incremental costs and as no evidence exists to support the contention that the company's total administrative costs are, in fact, increased by CCTV service, the customary charge of one percent was not applied¹⁶.

The cost of maintenance can be calculated by two methods. The simpler of the two involves the application of a maintenance factor, derived from past experience with similar equipment, to the gross investment in CCTV equipment. Applying the maintenance factor of 6.4% on the total gross investment of \$981,950 gives \$62,800.

The second method is more direct and involves putting the

¹⁶If applied, the administration charge for 1969 would have been \$9,800.

question, "What effect would removal of CCTV service have on your manpower requirements?" to the foremen of the two plant sections responsible for the maintenance and installation of CCTV systems. The answer was seven men or a possible saving of \$118,000 annually¹⁷. This figure must be adjusted for double accounting of installation costs since installation costs would have already been capitalized. The adjusted maintenance figure is \$81,700¹⁸.

Little can be said as to which method provides the more accurate estimate of maintenance costs. However, the study uses the latter method on the simple grounds that a reasoned calculation is preferred to an arbitrary apportioning of costs.

The total incremental costs, direct and indirect, generated by CCTV service in 1969 were \$227,700; \$146,000 in direct costs and \$81,700 in indirect costs.

Service Profitability

CCTV service in 1969 generated incremental revenues of \$103,500 and incremental expenses of \$227,700 resulting in an operating

¹⁷The loaded hourly labour rate is \$8.09/hour, thus total savings are \$8.07 (7) (173.5) (12) or \$118,000/year.

¹⁸Installation costs are 10% of equipment costs, therefore, adjustment for installation is \$406,300 (1-1/1.1) or \$36,300.

deficit of \$124,200.

Since the regulatory agency allows the company to earn a 5.9% return on total company net investment (gross investment less accumulated depreciation) and after operating expenses but before debt charges, CCTV service burdened other company services by \$124,200 plus 5.9% of \$981,950 or a total of \$182,200. In actual fact, the burden was even larger since the cost of new debt during 1969 was approximately 9% or about 3% greater than the allowable return.

The critical issue is the source of the \$182,200 required for CCTV service to reach a minimal level of profitability. If the source was excess profits from other unregulated competitive services, then there are no grounds for charges of unfair competition with other CCTV suppliers. However, if the \$182,200 was obtained from a monopoly-type service and particularly one exhibiting a low price elasticity such as basic exchange telephone service, the company could be accused of unfair competitive practices. This study does not identify the source of the \$182,200.

It could be argued with some justification that CCTV, being a rather new service, should not be expected to recover all operating costs during the early development of the service's potential. Whether a company enjoying a monopoly position in its major area of business should be allowed to employ a "deep pocket" strategy to enter a competitive service area is open to question. On paper, the company could

enter a new service area, absorb operating losses during the early years and eventually force the existing competition out.

But even if the argument is accepted, the company should be expected to maintain separate accounts for the service so as to identify the long-run profitability of the service.

Mobile Telephone Service - Study A

Service Description

Mobile Telephone Service (MTS) provides telephone service to moving vehicles¹⁹. The service is identical to that provided by a fixed telephone²⁰ except for operating restrictions imposed by the technical capabilities of the MTS equipment and differences in rate structures. For example, the equipment presently employed by the company in this study, requires an operator to establish each call whether the call is of a local or toll nature. Also, voice communication is on a one-way "push-to-talk" basis rather than being a simultaneous

¹⁹MTS is sometimes used to provide telephone service to fixed locations such as hunting lodges, drilling sites or other remote locations. In such cases, the cost of constructing permanent facilities are prohibitive either due to the nature of the terrain or the temporary need for the service.

²⁰A fixed telephone is defined as one permanently installed at a specific location such as a residence, business, farm, coin box, hunting lodge.

two-way conversation.

The rate structure for MTS consists of a flat-rate monthly charge for each mobile telephone plus a per message charge. Table 4 outlines the monthly flat-rate charges and table 5 the message charges.

Table 4

MTS MONTHLY FLAT-RATE CHARGES

In-vehicle equipment supplied and maintained by	Monthly Charge
Telephone company	1-6 channels; \$27 plus \$3/channel 8-13 channels; \$51
Customer	\$5

Table 5

MTS MESSAGE CHARGES

Type of Call	Charges
Local	
1. mobile-mobile	\$0.40 for 3 minutes plus \$0.10 per minute over 3 minutes
2. mobile-fixed telephone	\$0.30 for 3 minutes (zone A)* \$0.35 for 3 minutes (zone B)* plus \$0.10 per minute over 3 minutes
Toll	Person-person, daytime long- distance rates

* Zone A, fixed telephone is within 14 miles of MTS base stations;
zone B within 15-22 miles.

The dissimilarities of the rate structures between MTS and exchange service are striking. Exchange telephone service is on a flat-rate monthly charge basis with the rate varying according to the number of telephones within the exchange area and whether the customer usage is personal or business. Unlike the exchange rates which are independent of usage, MTS subscribers are charged a flat-rate charge plus a rate which is based on the number and length of each message. The purpose of such a dual-base rate structure is twofold. The per message rate reflects the operator costs incurred in establishing and monitoring the call and also serves to control uneconomic usage of the limited mobile facilities, while the flat-rate charge recovers the cost of in-vehicle and other usage-independent equipment.

Since MTS is not generally considered to be an essential service in the socio-economic development of the province, the service is not regulated. However, some industries, in particular the natural resource exploration industry and the construction industry, consider MTS service essential to their operations. But there are substitute services. For example, in developed areas, the customer can drive to the nearest coin box²¹ or the vehicle can be equipped with a private mobile system providing office-vehicle communication but having no

²¹This is a feasible alternative in view of the study by the company which indicated that 4 out of 5 calls involving MTS are originated from the vehicle and terminated by a fixed telephone.

access to the telephone network. In undeveloped areas, the only feasible alternative would be to equip the vehicles with a private mobile system. Table 6 provides a breakdown of MTS customers according to industry-type.

TABLE 6
MTS CUSTOMERS BY INDUSTRY*

Industry	Percentage of Total Customers
Oil and Gas	46
Construction	22
Government (Prov.)	8
Other	24

* Survey of customers by company in 1969

Depending on the nature of the call, MTS uses a varying portion of the total telephone network. Figure 4 schematically illustrates the three types of calls possible.

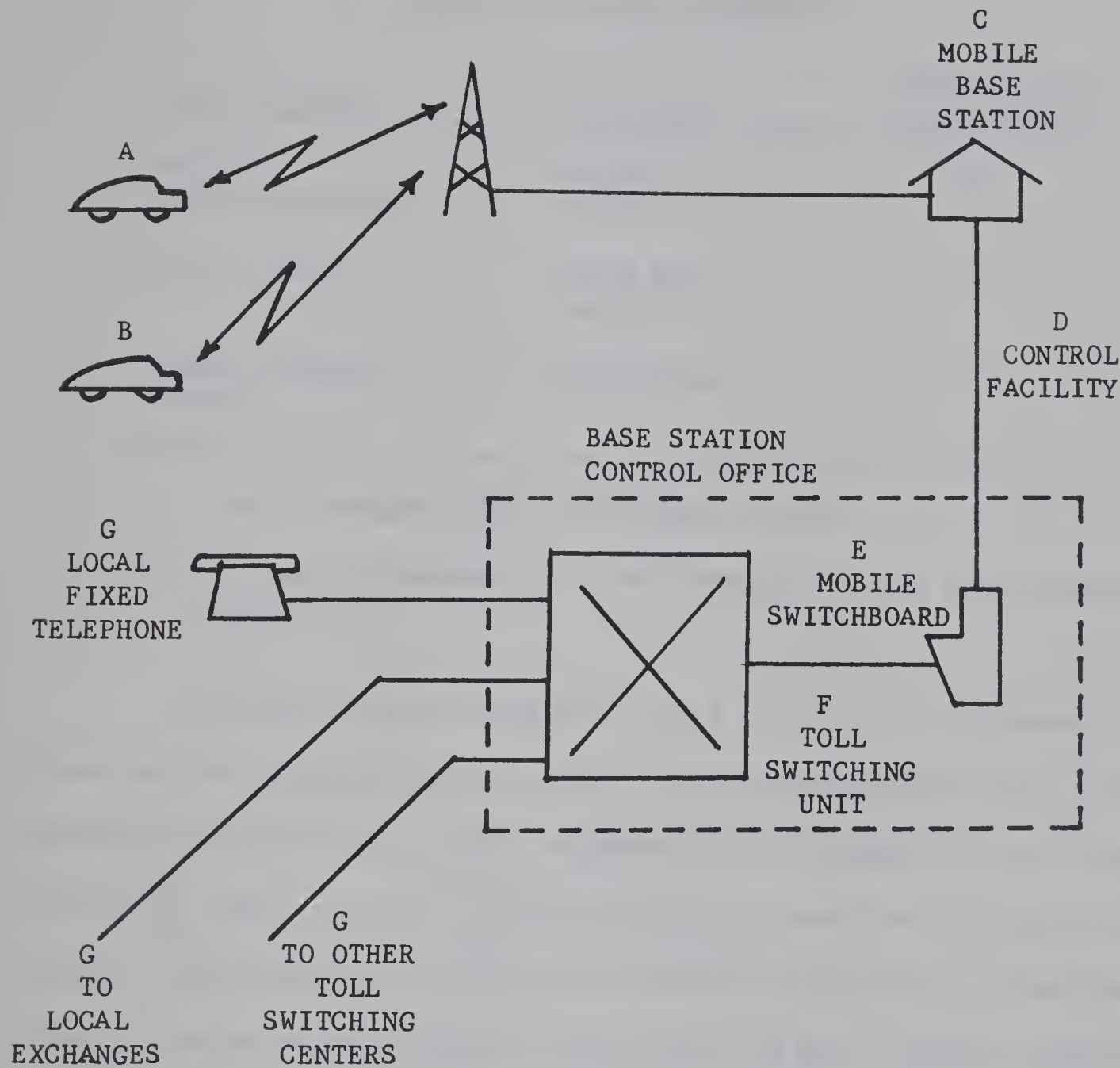


Figure 4 --- Routing of MTS Calls

Table 7 gives the routes taken by each of the call-types. Also shown in table 7 is the percentage of total calls contributed by each type of call (local and toll calls combined).

Table 7

MTS CALL ROUTING PATTERNS

Type of Call	Routing	Percentage of Total Calls*
Mobile-fixed telephone	A-C-D-E-F-G	82%
Mobile-mobile	A-C-D-E-**-D-C-B	2%
Fixed telephone-mobile	G-F-E-D-C-A	16%

* From a company study conducted in 1969.

** For simplification, toll mobile-mobile calls are considered negligible.

Equipment represented by A and B (in-vehicle equipment), C (base station equipment) and D (base station control facility) are required specifically for MTS. Although this equipment is not used jointly by other services, it often shares a joint facility or installation. For example, the mobile base station equipment is sometimes housed in an existing equipment office and the base station antenna on an existing radio tower. Similarly, the base station control facility is seldom provided as an individual installation but more generally consists of a single voice channel derived from an existing multi-channel facility.

The mobile switchboard equipment is normally not provided specifically for MTS. In most installations, the switchboards handling

long-distance traffic are equipped and the operators trained to handle either operator-assisted toll calls or mobile calls. Even in the odd case where separate switchboards are used for MTS, the switchboards also handle other services such as originating toll traffic from hotels and terminating of "ring down" circuits.

Beyond the switchboards, the equipment and facilities are common to all services using the telephone network. This includes local switching units, toll switching units, exchange facilities interconnecting local offices, toll facilities interconnecting toll offices or local offices and toll office, subscriber loops and the fixed telephone set. Figure 5 illustrates the telephone network.

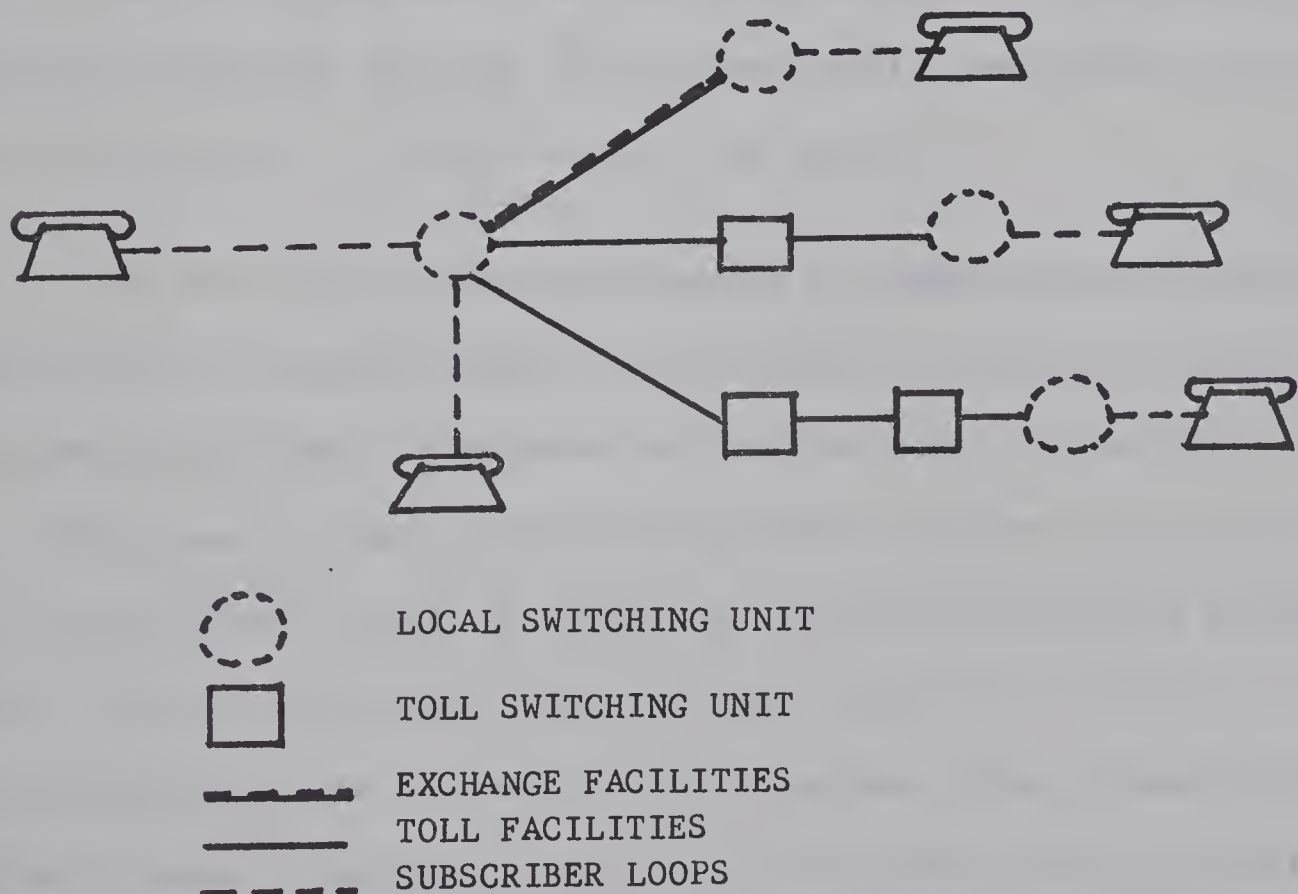


Figure 5 --- The Telephone Network

At the present time, MTS is a monopoly service available only from the local telephone company. This monopoly position is made possible by company regulations prohibiting the interconnection of private mobile telephone systems to the telephone network by any means including acoustic couplers. Whether this monopoly position will be maintained is open to question. Changes in policies of Canadian telephone companies have generally migrated from the U.S. after varying time lags. Examples of this effect are the two cases of service observation and the interconnection of customer-owned telephone sets. Until very recently, telephone companies systematically monitored both local and toll calls on a random basis, to ascertain the quality of service to their customers. Although the intent of this policy was unquestionably the continued improvement of service, the threat of an invasion-of-privacy lawsuit in the U.S. led to the almost simultaneous curtailment of the practice in Canada as well as the U.S.

In the U.S., continuing pressure by communication-industry companies and the general public led to a major relaxation of interconnection regulations. Customers may now own their own telephone sets, interconnect private switching and mobile systems and generally treat the telephone network as simply an information-carrying system. And this trend is continuing under the open approval of the U.S. federal administration. In early 1970, President Nixon presented to Congress a report prepared by the Council of Economic Advisors dealing with utility regulation. Some of the council's observations were as

follows²²:

"The American experience with regulation, despite notable achievements, has had its disappointing aspects. Regulation has too often resulted in protection of the status quo. Entry is often blocked, prices are kept from falling, and the industry becomes inflexible and insensitive to new techniques and opportunities for progress."

"Competition can sometimes develop outside the jurisdiction of a regulatory agency and make inroads on the regulated companies, threatening their profitability or even survival. In such cases, pressure is usually exerted to extend the regulatory umbrella to guard against this outside competition, so that the problems of regulation multiply and detract from the original purpose of preventing overpricing and unwanted side effects."

In summary the council stated, "When regulation has stifled competition, performance has deteriorated. The clearest lesson of all, however, is that regulation should be narrowed or halted when it has outlived its original purpose".

In Canada, the relaxation of regulations on interconnection has been slower. Subscribers may now interconnect with the telephone

²²Telecommunication News, Washington, D.C., Vol. 36, No. 6, February 9, 1970, p. 1-2.

network using suitable company-supplied couplers. For example, a subscriber can now own a telephone set (provided it is of a type not supplied by the company), a mobile telephone set (see study B), a data set or other communication device. However, Canadian companies have not relaxed the interconnection regulations to permit the interconnection of private switching or private mobile systems to the general telephone network. And until this happens, MTS will remain very much a monopoly service.

Service Revenue

The direct revenue generated by MTS consists of the monthly flat-rate charges and the interconnection fees charged customers using COAM (Customer Owned And Maintained) equipment. Table 8 lists this direct revenue for MTS for the year of 1968.

Table 8

DIRECT REVENUE FROM MTS

	1968
Monthly Charges	\$279,700*
Interconnection Fees	\$ 70,100

* Not included is \$135,200 representing monthly charges for mobile equipment in the company's vehicles (sometimes referred to as "deadhead" revenue).

Revenue is also generated by MTS as a result of message

charges. Table 9 gives the local and toll MTS calls for the years of 1967, 1968 and 1969.

Table 9

MTS LOCAL AND TOLL CALLS

	1967	1968	1969
Total Calls	512,800	558,100	624,500
Toll Calls	327,800	355,800	*
Local Calls	185,000	202,300	*
% Toll Calls	64.0	63.7	*

* Only the total number of calls is available for the year 1969.

The revenue generated by message charges for the calls per table 9 can only be approximated. For example, the 1968 revenue identified by the company's records is \$778,000 but this figure includes only the revenue generated by calls billed to an MTS number. That is, calls originated from a fixed telephone to a mobile (representing 16% of the total MTS calls) are not included²³. Adjusting the revenue for 1968 (dividing by 0.84) gives the total MTS revenue as \$926,000. The assumption is made that the average revenue per call is independent of whether the call is charged to an MTS number or to a fixed telephone

²³It is assumed that calls billed to a third number, charged to a credit card number or having the charges reversed, are insignificant.

number.

The question now, is what proportion of this \$926,000 is true incremental revenue, or in other words, what proportion of the local and toll calls per table 9 would have been made even if MTS did not exist. Obviously this is a difficult question to answer accurately but a crude estimate is possible. For one thing, it is highly unlikely that any of the fixed telephone-to-mobile calls would have been made if MTS did not exist²⁴. Also, no mobile-to-mobile calls would be possible without MTS. This leaves only the mobile-to-fixed telephone calls. It appears reasonable to assume that some proportion of these toll calls would have been made even if MTS did not exist. Placing a toll call implies the need for immediate information. Without MTS, the customer has the option of driving to the nearest fixed telephone and making his call. On this argument alone the analysis assumes that one out of four MTS mobile-to-fixed telephone toll calls and none of the local calls would have been made if MTS did not exist.

To obtain an estimate of the incremental revenue, the average revenue per toll call is required. If it is assumed that the average revenue per local call is \$0.50²⁵, the total revenue in 1968 from local message charges is 202,300 (\$0.50) or \$101,200. Thus the average

²⁴How often does one call someone located at a coin box?

²⁵The minimum charge per local call is \$0.30.

revenue per toll call is $\frac{\$926,000 - \$101,200}{355,800}$

or \$2.32 per toll call.

Thus the indirect incremental revenue is \$926,000 minus the amount of (0.82) (0.25) (355,800) (\$2.32)²⁶, i.e., \$926,000 less \$169,000 or a net incremental revenue of \$757,000.

The total incremental revenue, direct and indirect, is \$757,000 plus \$349,800 or \$1,106,800.

Service Costs

The direct cost of providing MTS includes the depreciation and maintenance expense of the equipment dedicated to the service. The depreciation expense is calculated on the straight-line method. Maintenance expense is based on a factor relating maintenance expense to original equipment cost²⁷. Table 10²⁸ lists the original cost of equipment installed and used exclusively by MTS.

²⁶The 0.82 is the percentage of mobile-to-fixed telephone calls; 0.25 is the percentage of toll calls which would have been made even if MTS did not exist.

²⁷The maintenance factor includes the loaded cost of labour and the cost of the necessary test equipment.

²⁸Table 10 does not include the 290 mobiles installed in the company's vehicles for internal use.

Table 10¹

ORIGINAL COST, DEPRECIATION FACTOR
AND MAINTENANCE FACTOR OF EQUIPMENT
INSTALLED SOLELY FOR MTS AS OF DEC. 31, 1968

Equipment	Original Cost	Factors	
		Depreciation	Maintenance
Mobile Sets	1,240,000	14.3%	12.0%
Base Stations	190,600	10.0%	13.3%
Control	214,000	10.0%	13.3%
Terminal	112,500	5.0%	6.0%
Total	1,757,100		

¹From a 1969 company study.

Operating switchboards, base station towers and buildings are not used exclusively for MTS. Thus a means of apportioning the capital cost and maintenance of this equipment is necessary. The method used in this analysis consists of apportioning the costs on the basis of usage by the joint services with the additional proviso that no costs are charged to MTS when one of the joint services is basic exchange or toll telephone service. This latter proviso assumes that MTS does not significantly increase the costs of the exchange and toll telephone networks. Table 11 lists the total calls handled by the company in 1968 and the number of MTS calls.

Table 11¹

TOTAL COMPANY CALLS AND
TOTAL MTS CALLS IN 1968
(millions)

Calls	Company	MTS	MTS % Company
Local	791.6	0.20	0.02
Toll	34.8	0.36	1.0
Total	826.4	0.56	

¹From company records.

Table 11 indicates that it is a reasonable assumption to consider the effect of MTS calls on the total costs of the telephone network as being insignificant. However, the switchboard and base station tower and building costs are apportioned, since the respective joint services are not basic services but hotel answering and private mobile service. Table 12 gives the apportioned original cost of such equipment and the associated depreciation and maintenance factors.

Table 12¹

APPORTIONED ORIGINAL COST OF JOINT
USE EQUIPMENT AS OF DEC. 31, 1968

Equipment	Apportioned Original Cost	Factors	
		Depreciation	Maintenance
Switchboards	78,000	10.0%	6.4%
Towers and Buildings	53,900	5.0%	1.2%
Total	131,900		

¹From a company study in 1969.

Table 13 summarizes the total direct costs generated by MTS. The annual expense factor is the sum of the depreciation expense factor, the maintenance expense factor and an additional 2% to represent the cost of administration of the service. This latter charge represents the costs of billing, marketing, advertising and other unallocable costs.

Table 13
DIRECT COSTS GENERATED BY MTS
IN 1968

Equipment	Apportioned Original Cost	Annual Expense Factor	Annual Costs
Mobile Sets	1,240,000	28.3%	350,600
Base Stations	190,600	25.3%	48,200
Control	214,000	25.3%	54,200
Terminal	112,500	13.0%	14,600
Switchboards	78,000	18.4%	14,300
Towers, Buildings	53,900	8.2%	4,400
Total	1,889,000		486,300

The major indirect costs generated by MTS are the costs of operators handling the mobile calls. With telephone companies increasing the mechanization of toll calls on a continuing basis by such advances as direct distance dialing, the cost of handling a call via an operator is steadily increasing. Two factors are contributing to this increase. One is the increased cost of labour; the second is the continuing decline in the number of calls handled leading to a higher fixed cost/call ratio.

Operator costs can, in general, be increased or decreased incrementally. For example, if an operator can handle on the average 20 calls/hour and the load increases from 100 to 120 calls/hour, then

an increase from 5 to 6 operators is required. However, if the increase is from 10 to 15 calls/hour, an extra operator is not required and no additional labour costs are incurred. The opposite occurs when the increase is from 18 to 22 calls/hour. In this latter case, the labour cost/call for each of the four additional calls would be five times the average. In this analysis, it is assumed that these two opposing cases will effectively cancel each other and thus allow the operators' costs to be determined on a purely incremental basis.

Based on a company study in 1969, the average annual cost per operator in 1968 was \$4100²⁹. Also, each operational switchboard required an average of 1.56 operators (to provide adequate 24 hour operation).

The company has 438 switchboards handling both MTS and toll traffic. Multiplying this number by the factors (1.56) (4100) (1.13)³⁰ $\frac{(558,000)}{13,852,000}$ ³¹ gives the total operating costs (except for one location

²⁹This figure includes salary and training of the operator but not supervision nor preparation of switchboard practices. Supervision and practice expense estimated at \$1000 per switchboard per year is not included since it is not an incremental MTS expense except for one location which is treated separately.

³⁰The 1.13 factor represents non-operating expenses which average 13% of total operating costs.

³¹This factor is the proportion of

$$\frac{\text{MTS calls}}{\text{total operator handled calls}}$$

where the switchboards are not shared with the MTS) apportioned to MTS. This cost is \$127,500.

One location has 13 switchboards to handle MTS, hotel answering service and ring down traffic. Based on judgement alone, 75% of the total operator costs of this location are charged to MTS and 25% to the other joint services. The total operator costs for this location are: $(13) (1.56) (4100) (1.13) (0.75) + 13 (1000) (.75)$ or \$80,200

Thus the total indirect costs generated by MTS are \$127,500 plus \$80,200 or \$207,700.

The total incremental costs (direct and indirect) generated by MTS in 1968 are \$486,300 plus \$207,700 or \$694,000.

Service Profitability

MTS, in 1968, generated total incremental revenue of \$1,106,800 consisting of \$349,800 in direct incremental and \$757,000 in indirect incremental revenue. The corresponding costs were \$486,300 in direct incremental costs and \$207,700 in indirect incremental costs. Thus the operating profit on MTS was \$412,800 for the year 1968.

On a year-end MTS investment of \$1,889,000 (original cost), the rate-of-return is approximately 21.8%.

MTS is an example of an unregulated monopolistic service generating operating profits in excess of the cost of capital and thus reducing the overall revenue requirements of other services. But it is important to consider that the regulatory agency in question allows only a 5.9% return on total plant investment. This means that \$301,300 of the \$412,800 must represent an operating loss on other services. If the other services are also monopoly services, the question simply becomes one of subsidizing the preferred service from a socio-economic aspect. If the other services are competitive (such as closed circuit television), the question becomes one of unfair competition with other suppliers of the service (such as CCTV).

Mobile Telephone Service - Study B

Study A examined mobile telephone service (MTS) from the singular aspect of whether or not the service was a financial burden on the company's monopoly services. Critical to the success of Study A, was the ability to accurately identify the long-run incremental revenues and costs generated by MTS. As pointed out, this was not a simple problem. The present revenue and cost accounting procedures employed by the company are too broad to accurately determine the total revenues or the total costs. For example, under the present revenue accounting procedures the company is unable to identify the direct revenue generated by MTS customers in placing local and long-distance calls from their vehicles. But even if the accounting procedures were

expanded to provide such information, there would still remain the problems associated with identifying indirect revenues and of apportioning joint costs in a relevant matter. Until studies are conducted into the price cross elasticity between competing services and into the "most correct" criterion for apportioning joint costs, indirect revenues and costs can only be approximated by judgement.

Study B examines MTS from a point-of-view which allows the questions of indirect revenues and costs to be considered as irrelevant. This is made possible by the company's practice of allowing MTS customers to either rent the in-vehicle equipment (mobile telephone set, antenna, interconnecting cables) from the telephone company or to obtain the equipment from a private competing firm. Under this latter option the customer may purchase his in-vehicle equipment outright, lease it on a term basis or rent it by the month, depending on the policy of the private company involved.

Service Description

Whether the MTS customer obtains his equipment from the telephone company or elsewhere has no effect on his access to the general telephone network or on his or the company's operating procedures. Also, the message rates for both local and long-distance calls are identical for both types of MTS customers. It is only in the flat-rate monthly charges that a difference exists. The flat-rate charges are as

follows:

1. \$30-51 per month (dependent on the channel capacity of the mobile set) for customers renting their in-vehicle equipment from the telephone company. Under this option the customer pays a \$35 installation charge³² and the company maintains the equipment free of charge at any of its service centers.
2. \$5 per month for customers providing their own in-vehicle equipment. The company terms this fee an "interconnection" fee. Payment of the fee entitles the customer to access and receive calls from the network in the exact same manner as customers renting their equipment directly from the telephone company.

For the prospective customer who has made the initial decision that MTS is a desirable service, he is faced with the second decision regarding his in-vehicle equipment. In many cases, the decision on equipment will be based entirely on economic grounds; the customer compares the monthly charge of \$30-51 with the option of paying a \$5 interconnection fee coupled with the cost of obtaining his own in-vehicle equipment. In some cases, particularly for customers with small fleets of vehicles, other considerations of an intangible nature

³²Installation charges are assumed to equal installation costs and thus may be considered irrelevant to the analysis.

are involved such as the benefit of company-provided maintenance, short leases and removal of risk of the obsolescence of the equipment.

There are a number of private firms operating in the company's territory which supply in-vehicle equipment. Many are small specialty firms, while others involve the major manufacturers of mobile telephone equipment such as Canadian General Electric, Canadian Motorola Electronics and Canadian Marconi. These firms have two basic means of competing with the telephone company for the business of providing in-vehicle equipment to MTS subscribers - by price and by the quality of service to the customer. In the service area, the telephone company generally provides superior maintenance because of its widespread maintenance facilities and its larger investment in skilled personnel and test equipment. Also, by purchasing in-vehicle equipment in large quantities and by tender, the company can generally obtain equipment at a lower unit cost and with some degree of control over its packaging and design. The private firm can benefit from a more personal customer relationship. Often the private firm can provide specialized installations on short notice and is not bound by the "red tape" often found in the large organization.

Service Revenue

Since the message charges are the same regardless of whether the telephone company or the customer provides the in-vehicle equipment,

the total incremental revenue generated per vehicle as a result of the company providing the equipment is simply the difference between the monthly rental charge and the interconnection fee. Depending on the number of channels supplied, the monthly incremental revenue is \$25-46 per vehicle. On a yearly basis, the incremental revenue is \$300-552 per vehicle.

It is assumed that the revenue generated by message charges is in no way dependent on the ownership of the in-vehicle equipment.

Service Costs

The company's monthly rental rates for in-vehicle equipment reflect the effects of several cost factors and a value-of-service factor. Equation (11) describes this relationship.

$$(11) \quad CNE + CME + VE_i + VS_i = MR$$

where

CNE represents a "fair" apportionment of the cost of the general telephone network to MTS,

CME represents an apportionment of the cost of common mobile equipment (base stations, mobile switchboards) to each MTS mobile unit,

VE_i represents the average cost of in-vehicle equipment,

i represents the number of channels supplied, and

VS_i is a value-of-service figure set by the company.

Equation (11) reduces to equation (12) for those customers supplying their own in-vehicle equipment.

$$(12) \quad CNE + CME + VS_i = IF$$

where

IF represents the interconnection fee charged by the telephone company.

The incremental cost can then be determined by subtracting the left-hand side of equation (12) from the left-hand side of equation (11), giving VE_i , the average cost of the in-vehicle equipment. This latter cost consists of the equipment depreciation and equipment maintenance.

The average purchase cost of in-vehicle equipment during 1970 was \$1360 (\$1235 per vehicle plus 10% for spares)³³. Depreciation expense is 194 per year based on an estimated useful life of 7 years and straight-line depreciation.

Maintenance expense per year is estimated at 12%³⁴ of original cost or \$163. Thus the total incremental cost generated by

³³The company purchases its in-vehicle equipment with all channels equipped and operative. Channels are then disabled to meet the individual requirements of the customer. For this reason, the analysis assumes an equipment cost which is independent of the number of channels.

³⁴Based on company experience with similar equipment.

the company supplying the in-vehicle equipment is \$357 per year.

Service Profitability

Since the incremental cost is independent of the number of channels, the profitability of the telephone company supplying the in-vehicle equipment is dependent solely on the number of channels requested by the customer. Table 14 shows this relationship between profitability and channels.

Table 14

PROFITABILITY OF COMPANY SUPPLYING IN-VEHICLE EQUIPMENT

Channels	Units	Annual Incremental		Profitability	
		Revenue/Unit	Expense/Unit	Operating Profit	Return
1	20	300	357	-57	-4.2%
2	85	336	"	-21	-1.5%
3	86	372	"	15	1.1%
4	94	408	"	51	3.8%
5	52	440	"	87	6.4%
6	82	472	"	123	9.1%
8-13	188	552	"	195	14.3%

Table 14 indicates that the company provides in-vehicle equipment at a return of from -4.2% to 14.3%, depending on the number of channels. The company appears to discriminate against those

customers having higher channel requirements. The argument can be made that the value of MTS increases with the number of channels, since additional channels enable the customer to use the service over a larger geographical area and also there is less chance of encountering an all-channel busy condition. However, if this argument is accepted, it should also be applied to customers providing their own in-vehicle equipment. The latter type of customer pays a \$5/month interconnection fee which is independent of the number of channels his equipment provides.

Table 15 lists the rates charged by three of the company's competitors in the supply of in-vehicle equipment. For example, a customer can obtain 8-channel equipment on a five-year lease-purchase plan at \$46/month (including maintenance and interconnection) compared to the company's \$51/month rental rate.

Table 15

RATES FOR IN-VEHICLE EQUIPMENT³

Company and Type of Contract	Equipment ¹	
	4-channel	8-channel
1. <u>Outright Purchase</u>		
Competitor A	1350	1645
" B	1415	1620
" C	1140	1500
Telephone Company	N/A	N/A
2. <u>Lease-Purchase (5 years)</u>		
Competitor A	N/A	N/A
" B	34/mo.	38/mo.
" C	27/mo.	36/mo.
Telephone Company	N/A	N/A
3. <u>Rental</u>		
Competitor A (1 year min.)	45/mo. ²	53/mo. ²
" B	N/A	N/A
" C (3 year min.)	40/mo.	48/mo.
Telephone Company (1 month min.)	39/mo. ²	51/mo. ²

¹Equipment although not identical, provides near-identical service quality and capability.

²Maintenance included.

³Interconnection fee of \$5/month not included.

Comparing the rates of the telephone company with the comparable rates of its competitors indicates that the company's rates are lower. However, the company nevertheless earned a 6.7% return on the rental of in-vehicle equipment. In fact, if the company's maintenance charges had not been so high (12% compared to the competitors 3-4%), the return would have been substantially higher³⁵.

Therefore, under the present rate structure for company supplied in-vehicle equipment and with the present interconnection fee of \$5/month, there is no evidence of unfair competition with other suppliers.

Study B provides an example of a case whereby a company could use the interconnection fee as a means of inhibiting competition. If the fee was used for such a purpose, the issue would center on the fairness of a company, enjoying a monopoly position in MTS, in establishing a rate structure (including the interconnection fee) which discriminates against those customers providing their own in-vehicle equipment. This is not to imply that rate discrimination per se is bad but only that rate discrimination which impedes competition is not in the public's interest.

³⁵One reason for this large difference in maintenance costs is the telephone company's diversified maintenance centers. The company undertakes maintenance on in-vehicle equipment at 24 different locations.

Some rate discrimination (by discrimination we mean rates which, by design, are not proportional to costs) is desirable and is in the public's interest. An example of desirable discrimination is the rate differential between residential telephone service and business telephone service. The rate for the latter service is often double that of the former, yet the costs are only slightly higher. This large differential has essentially no effect on the relative use of these two services (that is, the cross elasticity is low). The higher rate for business service is simply based on a higher service value.

However, the critical issue is who determines when discrimination is and is not in the public's interest. In practice only the government or its appointee, the regulatory agency, can decide on questions of public good. The government does not expect nor should it accept, rates designed to limit or curtail competition. If competition is deemed by the government as not in the public's interest, then a regulated monopoly is the obvious answer.

CHAPTER V

SUMMARY AND IMPLICATIONS OF THE RESULTS

Summary

The results of the three test cases are not inconsistent with the Averch and Johnson hypothesis that regulated public utilities compete unfairly with other firms in the supply of unregulated competitive services.

The first test involved closed-circuit television service (CCTV). CCTV is an unregulated service which is highly competitive. The results of the study indicated that during the test year of 1969, CCTV generated an operating loss of \$124,200 or a rate-of-return of -12.7%. However, due to the lack of separation of unregulated from regulated services, the effect of this operating loss on the overall profitability of the company was negligible. The effective loss to the company being related to the difference between the incremental cost of capital during 1969 and the allowable rate-of-return.

The second test involved mobile telephone service (MTS) - a service which is unregulated and in which the telephone company studied has a monopoly position. Based on the test year of 1968, MTS earned a rate-of-return of 22% on investment and thus contributed to the financial support of the company's other services. It is important to recognize, however, that the calculated rate-of-return was particularly

sensitive to two judgement factors. These were the proportion of toll revenue and the "proper" apportioning of joint costs to MTS.

The third test also involved MTS. This test investigated the interconnection fee which the telephone company charges MTS subscribers who supply their own in-vehicle MTS equipment (although the company has a monopoly position in MTS, the supply of in-vehicle equipment, i.e., the mobile telephone, is competitive). The results of the test indicated that the company was charging a fair rate for the company-supplied in-vehicle equipment when compared to the interconnection fee. This was a particularly critical test of the company's motives since competition could have been inhibited by the establishment of either an unrealistically high interconnection fee and/or an unrealistically low rate for company-supplied in-vehicle equipment.

Implications of the Results

To the Company's Management

The study was hampered by a lack of relevant information on the unregulated and regulated services of the company. If future studies are to be more fruitful, the following actions are required:

1. Two sets of accounts are needed - one for regulated monopoly services and another for unregulated competitive services.

2. Studies are required into the price-elasticity of all services.
3. Studies are required into the cross price-elasticity between competing company services.
4. Studies are required into the "fair and just" method of apportioning joint costs among the appropriate services.

In summary, if regulated public utilities are allowed to enter competitive areas without adequate and sufficiently detailed regulatory procedures, the company must take the necessary steps to defend themselves against charges of unfair competition.

To the Regulatory Agency

Regulatory agencies must examine the rationale of the present procedure of calculating a single rate-of-return for a regulated public utility. Regulatory agencies, responsible for firms operating in both regulated and unregulated service areas, must have adequate and detailed information to ensure that a firm's ventures into competitive areas are not subsidized by its monopoly services and that the firm does not unduly inhibit competition. At a minimum, the agency should expect the firm to establish separate revenue, costs and investment accounts for its regulated and unregulated services.

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